

STATUS REVIEW OF Arabis fecunda

U.S.D.A. FOREST SERVICE - REGION 1

BEAVERHEAD NATIONAL FOREST

MONTANA

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1989 Challenge Cost-share Project

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I. SPECIES INFORMATION

A. CLASSIFICATION

1. SCIENTIFIC NAME: Arabis fecunda Rollins.
2. COMMON NAME: Sapphire rockcress.
3. FAMILY: Brassicaceae (=Cruciferae, mustard family).
4. GENUS: According to Hitchcock *et al.* (1964), there are over one hundred species of Arabis in the Northern Hemisphere. In Montana, there are 12 known species (Dorn 1984, Rollins 1984).
5. SPECIES: Arabis fecunda was first collected in 1975 by Jaculyn Cory along the lower western flanks of the Sapphire Mountains. This specimen was subsequently determined to represent a new species (Rollins, 1984). Arabis fecunda is endemic to Montana; all of the currently known locations for this species occur on distinctive, highly metamorphosed, calc-silicate soils. These locations are within a 45-mile radius of one another.

B. PRESENT LEGAL OR OTHER FORMAL STATUS

1. FEDERAL STATUS

- a. U.S. FISH AND WILDLIFE SERVICE: Arabis fecunda is currently included in Category 2 of the U.S. Fish and Wildlife Service Notice of Review (U.S. Department of Interior 1985), under consideration for federal listing as a threatened taxon. Category 2 taxa (= federal candidate taxa) are those "...for which information now in possession of the Service indicates that proposing to list them as endangered or threatened species is possibly appropriate, but for which substantial data on biological vulnerability and threat(s) are not currently known or on file to support the immediate preparation of rules."
- b. U.S. FOREST SERVICE: Arabis fecunda is currently included on the Watch list in Region 1 (Northern Region) of the U.S. Forest Service. Watch plants include those species, subspecies or varieties that are not currently known to occur on National Forest

land, but which are suspected to occur on such lands owing to the presence of suitable habitat. Also, these are plants for which there is concern for population viability within a given state. If found on National Forest lands, these taxa would be designated as sensitive (U.S. Department of Agriculture 1988). Since the establishment of list, A. fecunda was confirmed from 5 locations on the Beaverhead National Forest. Thus, the status should be changed to sensitive on the U.S. Forest Service list.

2. **STATE:** Arabis fecunda is currently listed by the Montana Natural Heritage Program (Shelly 1989) as "imperiled in Montana because of rarity" (state rank = S2 (6-20 occurrences)).

This rank does not currently provide any direct legal protection for the species.

C. DESCRIPTION

1. **GENERAL NONTECHNICAL DESCRIPTION:** Arabis fecunda is a small, perennial forb, with one to many clusters of basal leaves, and flowering stems that reach 3-12 inches in height. The spatula-shaped basal leaves generally have a smooth margin, and are 1/2-1 inch in length, and 1/8 inch wide. The leaves on the flowering stem are smaller and clasp the stem. A vestiture of dense forked hairs cover the stems and leaves. Inflorescences are congested with flowers, each made up of four white petals 1/4-1/2 inch long, and about 1/8 inch wide. The nearly erect pedicels may be up to 1/2 inch long, and bear fruits 1-2 inches long, and about 1/20 inch wide. The fruits are densely hairy, and each side of the fruit contains a single row of round seeds (adapted from Lesica 1985).
2. **TECHNICAL DESCRIPTION:** Perennial with a simple or branched caudex, densely pubescent throughout, with fine dendritically-branched trichomes; stems erect to somewhat decumbent at base, simple or few branched, 1-3 dm. high; leaves hoary, dimorphic; basal leaves petiolate, spatulate to linear oblanceolate, entire or with a few broad teeth in the blade area, 1-3 cm. long, 2-4 mm. wide; caudine leaves sessile, entire or the lower with a few teeth, oblong, acute, sparingly auriculate to nonauriculate, 7-20 mm. long; inflorescences usually congested; sepals oblong, nonsaccate,

densely pubescent, 6-7 mm. long, ca. 2 mm. wide; petals white to purplish, obovate, not unguiculate, narrowing gradually from blade to point of insertion, 9-13 mm. long, 3-5 mm. wide; fruiting pedicels erect to slightly divaricately ascending, straight, 6-10 mm. long; siliques erect, congested, usually appressed to rachis, straight to slightly curved inward, 3-5 cm. long, ca. 1.5 mm. wide, valves densely pubescent, compressed between seeds; styles ca. 1 mm. long; seeds in a single row, suborbicular to slightly longer than broad, narrowly wing-margined all around, ca. 1.2 mm. in diameter, mucilaginous when wetted; cotyledons accumbent (adapted from Rollins 1984).

3. **LOCAL FIELD CHARACTERS:** The very erect fruits, and the dense greyish vestiture of branched hairs on the foliage and fruit, distinguish A. fecunda from all other Arabis species found in western Montana (Lesica 1985).

D. GEOGRAPHICAL DISTRIBUTION

1. **RANGE:** All 13 of the currently known populations of A. fecunda occur in southwestern Montana. There are four locations for A. fecunda along the western flanks of the Sapphire Mountains east of Hamilton, Ravalli County, Montana. Nine additional locations were recently documented (8 in 1988, 1 in 1989) from small drainages on the north and east flanks of the East Pioneer Mountains: Jerry Creek, Quartz Hill Gulch, Canyon Creek, Cattle Gulch, and Birch Creek.

The global distribution for this species is shown on Map 1, p. 4. The exact locations are shown on the maps in Section IV, pp. 31-38. The populations occur in Beaverhead (7), Ravalli (4), and Silver Bow (2) counties, Montana.

2. **CURRENT SITES:** In 1988 and 1989, field surveys of southwestern Montana revealed nine new populations of A. fecunda. This brings the total number of currently documented populations to 13. Five of the populations occur on lands that are partially or wholly privately owned, six are on lands managed by the U.S. Forest Service, and three are partially or wholly on lands managed by the Bureau of Land Management and/or State of Montana. The legal descriptions, elevations, USGS topographic map names, and locations of sites in Montana are

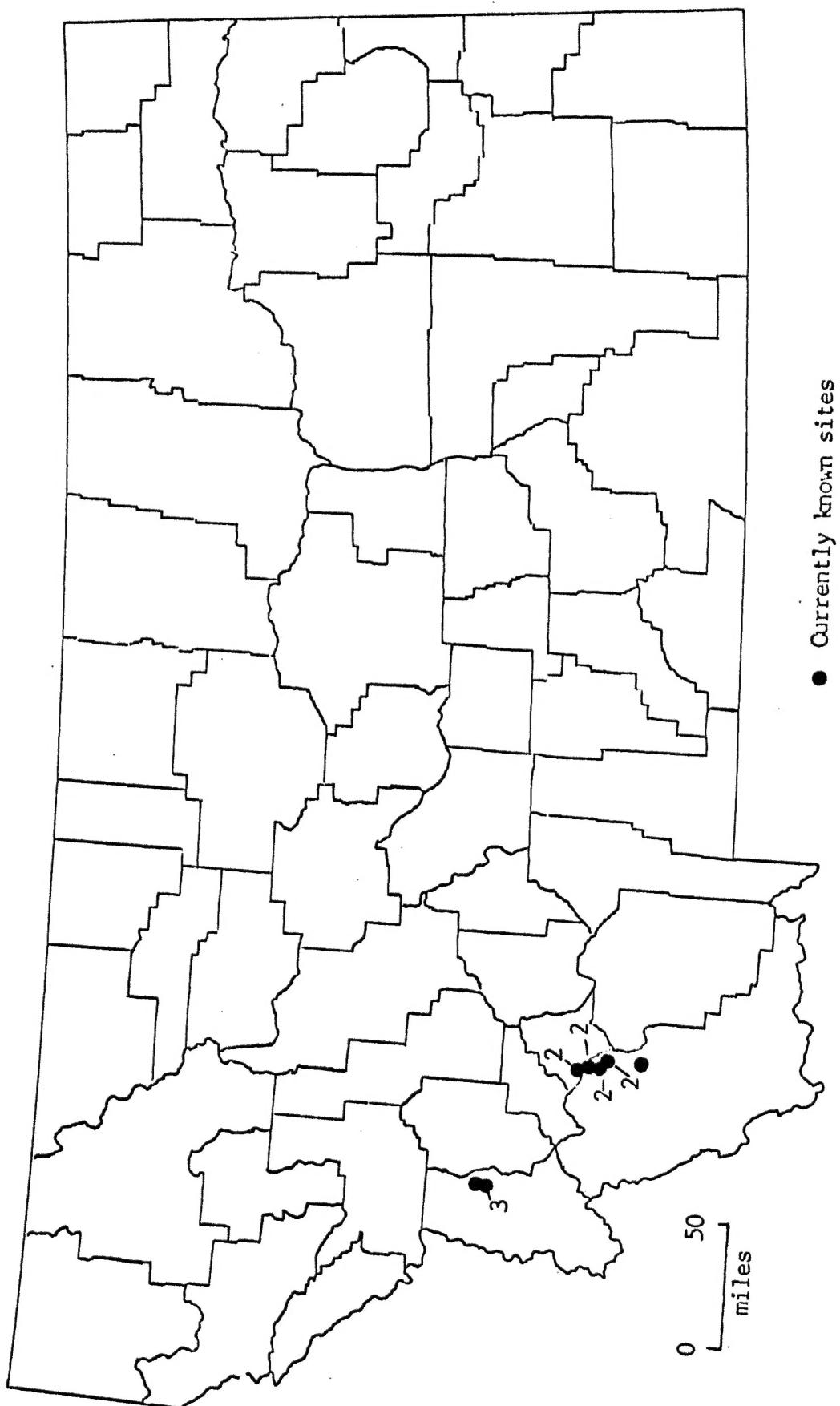


Figure 1. Global distribution of Arabis fecunda, Montana.

provided in Section IV, pp. 18-30. Also, the exact locations are indicated on the maps provided in Section IV, pp. 31-38.

Recent surveys for A. fecunda include:

Peter Lesica - The Nature Conservancy: May 1985.

J. Stephen Shelly - Montana Natural Heritage Program: 1-3 June 1988, 6-9 June 1989.

Lisa Ann Schassberger - Montana Natural Heritage Program: 1-3, 6-7, 13-15 June 1988, 6-9 June 1989.

3. **HISTORICAL SITES:** None.
4. **UNVERIFIED/UNDOCUMENTED REPORTS:** None.
5. **AREAS SURVEYED BUT SPECIES NOT LOCATED:** The following areas in Beaverhead County were searched in 1989, but no additional populations of Arabis fecunda were located. The actual areas surveyed were often smaller than the portions of the sections indicated. The list is organized by township, range and section number, and all sites are on Beaverhead National Forest land unless marked otherwise.

T1S, R 9W, Sec 31 SE $\frac{1}{4}$ of SE $\frac{1}{4}$ (BLM)
T1S, R10W, Sec 7 NE $\frac{1}{4}$ of NW $\frac{1}{4}$ (BLM)
T1S, R10W, Sec 17 SE $\frac{1}{4}$ of NW $\frac{1}{4}$
T1S, R11W, Sec 35 SE $\frac{1}{4}$ of NW $\frac{1}{4}$
T1S, R11W, Sec 35 NW $\frac{1}{4}$ of NW $\frac{1}{4}$
T1S, R11W, Sec 35 SE $\frac{1}{4}$ of SE $\frac{1}{4}$
T2S, R 8W, Sec 6 NE $\frac{1}{4}$ of SW $\frac{1}{4}$ (BLM)
T2S, R 9W, Sec 12 NW $\frac{1}{4}$ of NW $\frac{1}{4}$ (BLM)
T2S, R 9W, Sec 20 NW $\frac{1}{4}$ of SW $\frac{1}{4}$ (BLM)
T2S, R 9W, Sec 5 Central (BLM)
T2S, R10W, Sec 12 W $\frac{1}{2}$
T2S, R11W, Sec 2 SE $\frac{1}{4}$ of NW $\frac{1}{4}$
T2S, R11W, Sec 10 SE $\frac{1}{4}$ of SW $\frac{1}{4}$
T2S, R11W, Sec 15 NE $\frac{1}{4}$ of NW $\frac{1}{4}$
T3S, R 9W, Sec 8 SE $\frac{1}{4}$ of NW $\frac{1}{4}$ (BLM)
T3S, R 9W, Sec 7 SW $\frac{1}{4}$ of NE $\frac{1}{4}$ (BLM)
T3S, R 9W, Sec 12 S $\frac{1}{2}$ of NW $\frac{1}{4}$
T3S, R 9W, Sec 12 S $\frac{1}{2}$ of NE $\frac{1}{4}$
T7S, R11W, Sec 14 SE $\frac{1}{4}$ of NW $\frac{1}{4}$ (BLM)
T8S, R10W, Sec 25 SW $\frac{1}{4}$ of SW $\frac{1}{4}$ (Private)

E. **HABITAT:** The sites where populations of A. fecunda occur are distinguished by sandy or gravelly, light-colored, highly calcareous soils, derived from metamorphosed calc-silicate parent materials. These sites are found along small to large drainages at the edges of mountain uplifts, where these parent materials have been exposed by erosion.

Arabis fecunda populations occur in the sagebrush-grassland zone at locations in Ravalli, Silver Bow and Beaverhead counties. Additionally, some populations in Beaverhead County occur in dry Douglas-fir and lodgepole pine forest zones on open calcareous slopes. The sites range from 4,600 to 8,000 feet in elevation. Total vegetation cover at these sites is often low.

1. **ASSOCIATED VEGETATION:** Arabis fecunda populations occur most frequently in shrub- and grasslands, often near open, sparse stands of Pinus ponderosa (ponderosa pine), Pseudotsuga menziesii (Douglas-fir), or Juniperus scopulorum (Rocky Mountain juniper). The common native species associated with A. fecunda at one or more sites include:

Achillea millefolium (common yarrow)
Agropyron spicatum (bluebunch wheatgrass)
Artemisia frigida (fringed sagewort)
Artemisia tridentata (big sagebrush)
Astragalus miser (weedy milk-vetch)
Carex filifolia (thread-leaved sedge)
Castilleja pallens (palish indian-paintbrush)
Cercocarpus ledifolius (curley-leaf mountain mahogany)
Chrysopsis villosa (hairy goldenaster)
Crepis spp. (hawksbeard)
Cryptantha celosioides (northern cryptantha)
Draba oligosperma (few-seeded draba)
Erigeron compositus (cut-leaved daisy)
Eriogonum umbellatum (sulphur buckwheat)
Festuca idahoensis (Idaho fescue)
Gilia spicata (spicate gilia)
Haplopappus acaulis (cushion goldenweed)
Haplopappus armerioides (thrifty goldenweed)
Koeleria cristata (Junegrass)
Linum perenne (blue flax)
Lithospermum ruderale (wayside gromwell)
Mertensia oblongifolia (oblongleaf bluebells)
Oryzopsis hymenoides (indian ricegrass)
Oxytropis lagopus (haresfoot locoweed)

Penstemon aridus (stiff-leaved penstemon)
Phlox bryoides (moss phlox)
Phlox longifolia (long-leaved phlox)
Physaria geyeri (Geyer's twinpod)
Poa secunda (Sandberg's bluegrass)
Sedum lanceolatum (lance-leaved stonecrop)
Senecio canus (woolly groundsel)
Taraxacum officinale (common dandelion)
Tetradymia canescens (gray horsebrush)
Townsendia hookeri (Hooker's townsendia)

Additionally, sites on private land, Bureau of Land Management, and on State of Montana lands have been invaded by weedy introduced species, including Centaurea maculosa, Alyssum alyssoides, and Bromus tectorum.

2. **TOPOGRAPHY:** All known populations of Arabis fecunda are located on well-drained, lower to upper slopes or ridgelines, at elevations from 4,600 to 8,000 feet. Slope angles range from 10-40 percent. This species has also been found growing in small amounts of loose soil, atop rocky calcareous outcrops.
3. **SOIL RELATIONSHIPS:** The four A. fecunda sites that occur along the west slope of the Sapphire Mountains occur on a calc-silicate unit of the Wallace Formation, and are just south of a large granitic intrusion, the Willow Creek Stock (Presley 1971).

The A. fecunda sites along the flanks of and in the East Pioneer Mountains occur on the upper part of the Madison Limestone Formation, comprised of metamorphosed limestone and sandstones, and on the Threeforks Formation, comprised of grayish-brown argillaceous limestone (Richards and Pardee 1925). These substrates appear similar to those occupied by populations along the Sapphire Mountains.

The distinctiveness of the soils indicates that they are a factor in the distribution of A. fecunda populations.

On a microsite level, A. fecunda may be associated with cryptogamic soil crusts. Results of a study at Charleys Gulch (001) and Birch Creek (004) in Ravalli County are included in Schassberger (1988).

4. **REGIONAL CLIMATE:** The regional climate of southwestern Montana is characterized by hot dry

summers, and cold, snowy winters. The highest amounts of precipitation come in the form of rain in spring.

The weather collection site at Hamilton is approximately 5 miles west, and 1000 feet lower than the 4 populations located along the flanks of the Sapphire Mountains. For the period from 1951-1980, the July mean temperature was 67.0° F, the January mean was 25.0° F, and the mean annual precipitation was 13.11 inches. The long-term weather station nearest to the populations in the East Pioneer Mountains is at Divide. This station is approximately 3.5-20 miles distant from the A. fecunda sites, and at an elevation of 5,395 feet. This is up to 2,500 feet lower than some of the A. fecunda sites. At Divide, the July mean temperature was 63.3 °F, the January mean was 19.1 °F, and the average annual precipitation was 12.39 inches (U.S. Department of Commerce 1982).

F. POPULATION DEMOGRAPHY AND BIOLOGY

1. **PHENOLOGY:** The phenology of the A. fecunda populations is variable due to the wide range in elevations at which they are found (4,600 - 8,000 feet), and differences in their topographical position. At lower elevation sites or sites with a more southern aspect, or in dryer habitats, A. fecunda begins to flower in early May. Mature fruit is present from late May-June on (Lesica 1985). At higher elevations, or on sites with a more northern or western exposure, flowering and fruiting may extend into early July.
2. **POPULATION SIZE AND CONDITION:** Populations of A. fecunda range in size from 75 to 10,000 plants with an average size of about 1,000. Most of the populations along the flanks of the Pioneer Mountains are in good condition. However, the A. fecunda populations along the flanks of the Sapphire Mountains have been invaded by various introduced species. Interspecific competition with Centaurea maculosa is of primary concern at these locations. Transects were established at Charleys Gulch (001) and Birch Creek (004) in Ravalli County, to gather information on life history and population trends for A. fecunda. Reports from an ongoing study of the interactions between these two species is contained in Schassberger (1988, 1990). The effects of Centaurea maculosa invasion on the fecundity of A.

fecunda are also discussed in Hamilton and Mitchell-Olds (1989).

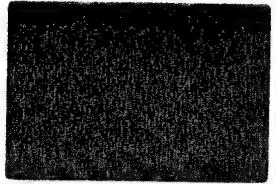
Transects were also established in 1989 at two locations on the Beaverhead National Forest (Slides, p. 10). Preliminary data indicate that fecundity, measured as number of plants fruiting, percent of plants fruiting, number of fruits per fruiting plant, and number of fruits per inflorescence, was lower (in 1989) at Lime Gulch (012) than at Canyon Creek (013). However, the Lime Gulch population is approximately 1,000 feet lower in elevation than Canyon Creek (011), and is located on the lower eastern flanks of the Pioneer Mountains in the rain shadow of some of the highest peaks of the range. Thus, it is likely to receive substantially less precipitation and have warmer temperatures than the Canyon Creek population. This in turn influences the phenology and possibly the fecundity of the populations. The data indicate that there needs to be at least a one to two week delay in reading the Canyon Creek transects, in order to obtain data comparable to Lime Gulch. The report on this study is found in Appendix A, p. 45.

3. REPRODUCTIVE BIOLOGY

- a. **TYPE OF REPRODUCTION:** Arabis fecunda is a perennial species that reproduces only by seed. Individual plants continue to grow larger each year through branching and enlargement of the caudex. Early bloom dates may indicate that A. fecunda is facultatively autogamous (Lesica 1985).
- b. **POLLINATION BIOLOGY:** The mechanisms of pollination are unknown for this species; however, it may be through selfing and/or by insects.
- c. **SEED DISPERSAL AND BIOLOGY:** Flowers and fruits mature acropetally, developing from the base of the plant to the apex. The often numerous fruits mature quite quickly. Although not directly observed, dispersal of seed is probably similar to that of other species of Arabis. Valves of the siliques open from the tip downwards, which expose the seeds that then drop, or are shaken to the ground (Lesica 1985).

ARABIS FECUNDA
Monitoring transect

MTNHP

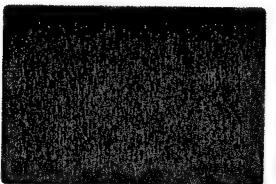


Steve Shelly

Lime Gulch
South Transect 6/15/89 1

ARABIS FECUNDA
Monitoring Transect

MTNHP

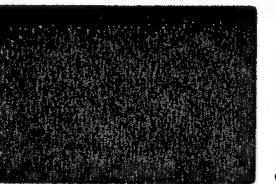


Steve Shelly

Lime Gulch
North Transect 6/15/89 4

ARABIS FECUNDA
Monitoring Transect

MTNHP

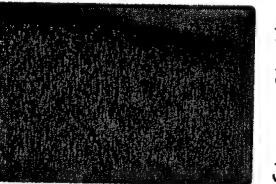


Steve Shelly

Lime Gulch
North Transect 6/15/89 7

ARABIS FECUNDA
Monitoring Transect

MTNHP



Steve Shelly

Canyon Creek
West Transect 6/16/89 10

ARABIS FECUNDA
Monitoring Transect

MTNHP

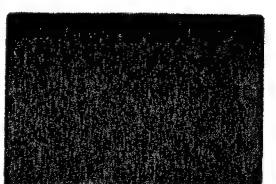


Steve Shelly

South Transect
Lime Gulch 6/15/89 2

ARABIS FECUNDA
Monitoring Transect¹⁰

MTNHP

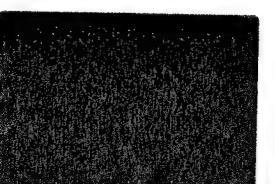


Steve S

Lime Gulch
South Transect 6/15/89 3

ARABIS FECUNDA
Monitoring Transect

MTNHP

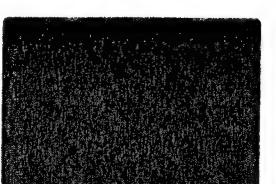


Steve Shelly

Lime Gulch
North Transect 6/15/89 5

ARABIS FECUNDA
Monitoring Transect

MTNHP

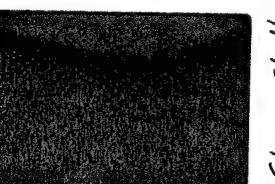


Steve Shelly

Lime Gulch
North Transect 6/15/89 6

ARABIS FECUNDA
Monitoring Transect

MTNHP

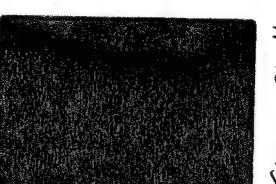


Steve Shelly

Canyon Creek
East Transect 6/16/89 8

ARABIS FECUNDA
Monitoring Transect

MTNHP

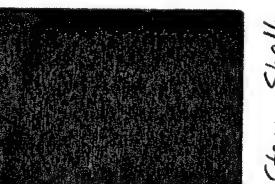


Steve Shelly

Canyon Creek
East Transect 6/16/89 9

ARABIS FECUNDA
Monitoring Transect

MTNHP

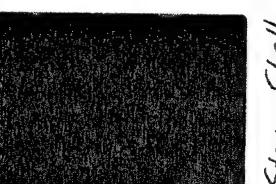


Steve Shelly

Canyon Creek
West Transect 6/16/89 11

ARABIS FECUNDA
Monitoring Transect

MTNHP



Steve Shelly

Canyon Creek
West Transect 6/16/89 12

Siliques were often observed to have been grazed, apparently by small mammals. This may aid in seed dispersal; however, it also may lower fecundity.

G. POPULATION ECOLOGY

1. BIOLOGICAL INTERACTIONS

- a. **COMPETITION:** Most populations of A. fecunda are too dispersed across the landscape for intraspecific competition to be a factor. However, interspecific competition between A. fecunda and Centaurea maculosa is considered to be a major threat to the four populations along the flanks of the Sapphire Mountains. Reports from an ongoing study of the interactions between these two species at these locations is contained in Schassberger (1988, 1990). See also Hamilton and Mitchell-Olds (1989).
- b. **HERBIVORY:** Although A. fecunda does not appear to be preferred by cattle, several sites were heavily disturbed by the trampling associated with grazing, and recently extirpated plants were observed.

Small mammals apparently graze on siliques; unless this is excessive, it is probably not detrimental to populations.

H. LAND OWNERSHIP

- 1. The land ownership for the 13 occurrences currently known in Montana is given below; several of the sites occur in areas of mixed ownership that include private, Bureau of Land Management, and State of Montana lands. The exact locations are provided in Sect. IV, pp. 17-38.

- a. **U.S.D.A. Forest Service:**

- i. **Beaverhead National Forest**

- Wise River Ranger District:**

- Quartz Hill (005)
 - Mouth of Quartz Hill Gulch (006)-portion
 - Upper Quartz Hill Gulch (008)
 - Canyon Creek (011)
 - Cattle Gulch (013)

Dillon Ranger District:

Lime Gulch (012)

b. U.S.D.I. Bureau of Land Management:**i. Butte District Office, Headwaters Resource Area:**

Mouth of Quartz Hill Gulch (006)-portion
Jerry Creek (007)-portion
Spring Gulch II (009)
Wise River (010)-portion

c. State of Montana:**i. Department of State Lands:**

Charleys Gulch (001)-portion
Birch Creek Bluffs (004)-portion
Jerry Creek (007)-portion

d. Private ownership:

Charleys Gulch (001)-portion
Spring Gulch I (002)
Rock Quarry Gulch (003)
Birch Creek Bluffs (004)-portion
Wise River (010)-portion

II. ASSESSMENT AND MANAGEMENT RECOMMENDATIONS**A. THREATS TO CURRENTLY KNOWN POPULATIONS:**

1. **GRAZING:** Arabis fecunda does not appear to be preferred by domestic grazers. However, the Jerry Creek population (007), Silver Bow County, and the Birch Creek (004) and Charleys Gulch (001) populations, Ravalli County, have been impacted by the trampling associated with grazing.
2. **MINING:** A subpopulation of A. fecunda plants at the intersection of Highway 43 and Quartz Hill Gulch (site = The Mouth of Quartz Hill Gulch (006), BLM managed land) is threatened by gravel removal from the base of the hill.

Subpopulations of Upper Quartz Hill Gulch (008) are near areas where mining has occurred in the past. This population could be impacted, should mining activities resume in the future.

3. **TIMBER HARVESTING:** No known threats.
4. **WEED CONTROL ACTIVITIES:** The Mouth of Quartz Hill Gulch (006), Jerry Creek (007), Wise River (010), Canyon Creek (011), Lime Gulch (012), and Cattle Gulch (013) are populations that are close to roads on public lands, and are potentially threatened by herbicide spray programs.

The Bureau of Land Management, Butte District, Weed Control Department requested and received locationJ information on the A. fecunda sites that occur on their lands including Mouth of Quartz Hill (006), Jerry Creek (007), Spring Gulch II (009) and Wise River (010).

- B. **MANAGEMENT PRACTICES AND RESPONSE:** From field observations, A. fecunda plants do not respond well to strong disturbances such as gravel removal, or trampling by livestock. Ongoing monitoring studies may reveal a relationship between A. fecunda and undisturbed cryptogamic soil crusts (Schassberger 1988).
- C. **RECOMMENDATIONS FOR MAINTAINING VIABLE POPULATIONS:** The following recommendations are made to insure that the long-term viability of Arabis fecunda populations on U.S. Forest Service lands in Montana is maintained:
 1. Protection of natural habitats that currently support populations. Populations that occur wholly on U.S. Forest Service lands should be considered in any habitat alteration or changes in management proposed on lands in their vicinity. If disturbance is proposed within or near the populations, detailed surveys should be conducted, and mitigation measures developed, to reduce or eliminate project impacts. Road improvement could impact the Canyon Creek (011) population, while an increase in mining activity would negatively affect the subpopulations at the Upper Quartz Hill Gulch (008) site. Changes in grazing systems would be important in all cases.
 2. Notification of weed control and road maintenance crews, range conservationists, and all other appropriate U.S. Forest Service personnel, of population locations. Maps detailing locations of populations should be provided to all personnel concerned with these activities, to reduce or eliminate unnecessary impacts to populations.

D. RECOMMENDATIONS FOR FURTHER ASSESSMENT:

1. Further field surveys of potential habitats in southwestern Montana. Much of the suitable habitat for A. fecunda in southwestern Montana has been surveyed. It is possible that there are more locations for this species on the Beaverhead National Forest; however, surveys in 1986, 1987, 1988 and 1989, covered much of the potential habitat.
2. Monitoring studies on U.S. Forest Service lands. Permanent belt transects, using the methods of Lesica (1987), are currently established at two locations on private lands in Ravalli County (Charleys Gulch (001) and Birch Creek (004)), and at two locations on Beaverhead National Forest lands (Lime Gulch (012) and Canyon Creek (011)). These transects should continue to be monitored, as they will provide important information on the life history and ecology of A. fecunda.

E. SUMMARY

Arabis fecunda is a recently described species (Rollins 1984) in the Mustard family. Four years of extensive searching have revealed only 13 locations for this species, all of which occur in southwestern Montana (Ravalli (4), Beaverhead (7), and Silver Bow (2) counties). Knapweed invasion threatens the four locations in Ravalli County, while grazing activities may threaten the two populations in Silver Bow County.

Region 1 (Northern Region) of the U.S. Forest currently lists A. fecunda as a Watch List species. With the newly discovered (1988, 1989) locations for this species on the Beaverhead National Forest, the status of A. fecunda should be changed to Sensitive in Region 1. Due to the limited distribution of Arabis fecunda, it is important to take the areas that contain populations into consideration when planning land use activities that may affect these populations.

Ongoing studies of the life history of A. fecunda should provide useful information pertaining to the management of this rare species.

III. LITERATURE CITED

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IV. ELEMENT OCCURRENCE PRINT-OUTS AND MAPS

ARABIS FECUNDA
SAPPHIRE ROCKCRESS

Element occurrence code: PDBRA06290.001

Global rank: G2 Forest Service status: WATCH LIST
State rank: S2

Survey site name: CHARLEYS GULCH
County: Ravalli

USGS quadrangle: CORVALLIS
WILLOW MOUNTAIN

Township-range: 006N019W Section: 20 W2, W2NE4
Township-range comments: Sec 19 S2; Sec 29 NW4; Sec 30 N2

Survey date: 1988-06-01 Elevation: 5000
First observation: 1975 Slope/aspect:
Last observation: 1988-06-01 Size (acres): 700

Location: WEST SLOPE OF SAPPHIRE RANGE, ALONG CHARLEYS GULCH ROAD,
CA. 1.1-2.1 MILES FROM JUNCTION WITH PAVED COUNTY ROAD; ALSO NORTH AND
SOUTH OF GULCH.

Element occurrence data:

CA. 8000-10000+ PLANTS, IN 13 SUBPOPULATIONS; EVIDENCE OF
DISTURBANCE BY CATTLE; WEED INVASION BY SPOTTED KNAPWEED
(CENTAUREA MACULOSA) A SERIOUS THREAT.

General site description:

ON STEEP, W- AND SW-FACING SLOPES, ON LIGHT-COLORED
CALCAREOUS OUTCROPS, IN SAGEBRUSH GRASSLAND WITH CHRYSOPSIS
VILLOSA, GILIA SPICATA, PHYSARIA GEYERI, AND ALYSSUM ALYSOIDES.

Land owner/manager:

PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE)
STATE LAND - UNDESIGNATED

Information source:

SHELLY, J.S. 1988. FIELD SURVEYS IN RAVALLI COUNTY OF 19-20
MAY, 1-3 JUNE.

ARABIS FECUNDA
SAPPHIRE ROCKCRESS

Element occurrence code: PDBRA06290.002

Global rank: G2 Forest Service status: WATCH LIST
State rank: S2

Survey site name: SPRING GULCH I
County: Ravalli

USGS quadrangle: MOUNTAIN HOUSE

Township-range: 006N019W Section: 30 S2
Township-range comments: Sec 31 NE4NW4

Survey date:	1988-06-01	Elevation:	4740
First observation:	1985	Slope/aspect:	
Last observation:	1988-06-01	Size (acres):	160

Location:

SPRING GULCH, WEST SLOPE OF SAPPHIRE RANGE; AT JCT. OF HWYS. 269 & 380, 2.5 MI. E. TO WHERE 380 TURNS N.; E. 1.5 MI. TO CHARLEYS GULCH RD., 2 MI. TO CATTLEGARD; SITES 1 MI. SW.

Element occurrence data:

CA. 1000-1500+ PLANTS, 4 SUBPOPULATIONS; EVIDENCE OF DISTURBANCE BY CATTLE; SITES THREATENED BY WEEDY SPECIES (ESP. CENTAUREA MACULOSA); REMOTE AREA.

General site description:

ON LIGHT-COLORED GRANITIC AND CALCAREOUS ROCK OUTCROPS, ON STEEP, S-FACING SLOPES; SAGEBRUSH GRASSLAND WITH PINUS PONDEROSA, HAPLOAPPUS ARMERIOIDES, GILIA SPICATA AND CRYPTANTHA sp.

Land owner/manager:

PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE)

Information source:

SHELLY, J.S. 1988. FIELD SURVEYS IN RAVALLI COUNTY OF 19-20 MAY, 1-3 JUNE.

ARABIS FECUNDA
SAPPHIRE ROCKCRESS

Element occurrence code: PDBRA06290.003

Global rank: G2 Forest Service status: WATCH LIST
State rank: S2

Survey site name: ROCK QUARRY GULCH
County: Ravalli

USGS quadrangle: MOUNTAIN HOUSE

Township-range: 006N019W Section: 31
Township-range comments: NW4SW4

Survey date:	1988-06-01	Elevation:	4850
First observation:	1985	Slope/aspect:	
Last observation:	1988-06-01	Size (acres):	5

Location:

ROCK QUARRY GULCH; FROM JCT. OF HWYS. 269 & 380, GO 2.5 MI.
E. TO CORNER WHERE 380 TURNS N.; GO E. 1.5 MI. TO CHARLEYS
GULCH RD., & 2 MI. TO CATTLEGUARD; SITE IS 2 MILES SW.

Element occurrence data:

CA. 800-1000+ PLANTS, ONE POPULATION; EVIDENCE OF LIGHT
DISTURBANCE BY CATTLE; POPULATION THREATENED BY KNAPWEED
(CENTAUREA SP.) INVASION, BUT SITE NOT AS WEEDY AS OTHERS IN
AREA.

General site description:

ON LIGHT-COLORED ROCK OUTCROPS ON OPEN, S-FACING SLOPES; IN
SAGEBRUSH GRASSLAND NEAR LOWER TREELINE, W/ SCATTERED PINUS
PONDEROSA, AGROPYRON SPICATUM AND HAPLOPAPPUS ARMERIOIDES.

Land owner/manager:

PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE)

Information source:

SHELLY, J.S. 1988. FIELD SURVEYS IN RAVALLI COUNTY OF 19-20
MAY, 1-3 JUNE.

ARABIS FECUNDA
SAPPHIRE ROCKCRESS

Element occurrence code: PDBRA06290.004

Global rank: G2 Forest Service status: WATCH LIST
State rank: S2

Survey site name: BIRCH CREEK BLUFFS
County: Ravalli

USGS quadrangle: WILLOW MOUNTAIN
CORVALLIS

Township-range: 007N019W Section: 16 NW4
Township-range comments: Sec 17, Sec 18 NE4, Sec 20 NE4

Survey date: 1988-06-01 Elevation: 4700
First observation: 1986 Slope/aspect:
Last observation: 1988-06-01 Size (acres): 200

Location:

WESTERN LOWER SLOPES OF SAPPHIRE MOUNTAINS, ALONG BIRCH CREEK AND TRIBUTARY NW. OF SCHOOLHOUSE BUTTE, CA. 7 AIR MILES ENE. OF CORVALLIS, MT.

Element occurrence data:

10,000+ INDIVIDUALS, CA. SIX SUBPOPULATIONS; SOME SLOPES ARE TERRACED FROM LIVESTOCK GRAZING, AND WEEDS (CENTAUREA MACULOSA, BROMUS TECTORUM, ALYSSUM) ARE ABUNDANT; ALSO WITH AGROPYRON SPICATUM, OXYTROPIS BESSEYI, AND SENEPIO CANUS.

General site description:

WHITE, HIGHLY CALCAREOUS, ERODING SLOPES OF METAMORPHOSED CALC-SILICATES; WITH PINUS PONDEROSA, JUNIPERUS SCOPULORUM, HAPLOAPPUS ARMERIOIDES, LESQUERELLA ALPINA, AND POA SECUNDA.

Land owner/manager:

STATE LAND - UNDESIGNATED
PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE)

Information source:

SHELLY, J.S. 1988. FIELD SURVEYS IN RAVALLI COUNTY OF 19-20 MAY, 1-3 JUNE.

ARABIS FECUNDA
SAPPHIRE ROCKCRESS

Element occurrence code: PDBRA06290.005

Global rank: G2 Forest Service status: WATCH LIST
State rank: S2

Survey site name: QUARTZ HILL
County: Beaverhead

USGS quadrangle: VIPOND PARK

Township-range: 001S011W Section: 36
Township-range comments: CENTER

Survey date:	1989-06-06	Elevation:	7960
First observation:	1986	Slope/aspect:	8-35% / SW
Last observation:	1989-06-06	Size (acres):	5

Location:

PIONEER MOUNTAINS, ECHO GULCH, SOUTHWEST BASE OF QUARTZ HILL, CA. 5 AIR MILES SSW OF DEWEY, MT.

Element occurrence data:

CA. 375-500 PLANTS, MOST STERILE IN 1989; SOME LIGHT GRAZING IN PAST, MINING IN NEARBY AREAS.

General site description:

ON OPEN, GRAVELLY CALCAREOUS SLOPE, IN PINUS CONTORTA ZONE, WITH DRABA OLIGOSPERMA, TOWNSENDIA PARRYI, ERIGERON COMPOSITUS, AND IVESIA GORDONII.

Land owner/manager:

BEAVERHEAD NATIONAL FOREST, WISE RIVER RANGER DISTRICT

Information source:

SHELLY, J.S. 1989. FIELD SURVEYS IN BEAVERHEAD COUNTY, 5-9 JUNE.

ARABIS FECUNDA
SAPPHIRE ROCKCRESS

Element occurrence code: PDBRA06290.006

Global rank: G2 Forest Service status: WATCH LIST
State rank: S2

Survey site name: MOUTH OF QUARTZ HILL GULCH
County: Beaverhead

USGS quadrangle: DEWEY

Township-range: 001S010W Section: 08 E2
Township-range comments: Sec 5 SE4; Sec 17 NE4

Survey date:	1988-06-06	Elevation:	5780
First observation:	1988	Slope/aspect:	
Last observation:	1988-06-13	Size (acres):	100

Location:

TRAVEL 0.25 MILE WEST OF DEWEY, MT ON HIGHWAY 43, THEN SOUTH
ON QUARTZ HILL GULCH ROAD, EAST AND WEST OF THE ROAD FOR 1.5
MILES.

Element occurrence data:

CA. 7,300 PLANTS IN 8 SUBPOPULATIONS; FRUITING.

General site description:

CALC-SILICATE ROCKY OUTCROPS AND HILLSIDES; BENEATH
JUNIPERUS SCOPULORUM AND PSEUDOTSUGA MENZIESII, WITH
CERCOCARPUS LEDIFOLIUS AND DRABA NIVALIS.

Land owner/manager:

BLM: DILLON RESOURCE AREA, BUTTE DISTRICT
BEAVERHEAD NATIONAL FOREST, WISE RIVER RANGER DISTRICT

Information source:

SCHASSBERGER, L.A. 1988. FIELD SURVEY, SOUTHWEST MONTANA,
1-3, 6-7 AND 13-15 JUNE.

ARABIS FECUNDA
SAPPHIRE ROCKCRESS

Element occurrence code: PDBRA06290.007

Global rank: G2 Forest Service status: WATCH LIST
State rank: S2

Survey site name: JERRY CREEK
County: Silver Bow

USGS quadrangle: WISE RIVER

Township-range: 001N010W Section: 31 SW4
Township-range comments: T1N R11W:Sec 36 SE4

Survey date:	1988-06-07	Elevation:	5700
First observation:	1988	Slope/aspect:	
Last observation:	1988-06-07	Size (acres):	30

Location:

CA. 1.5 MILES EAST OF WISE RIVER, MT, ON HIGHWAY 43, NE ON JERRY CREEK ROAD 0.3 MILE; HILLSIDES AND OUTCROPS EAST OF ROAD.

Element occurrence data:

CA. 5,050 PLANTS IN 2 SUBPOPULATIONS, FLOWERING AND FRUITING; THREATENED BY OVERGRAZING.

General site description:

ON CALC-SILICATE OUTCROPS & HILLSIDES IN OPEN SOILS, BENEATH JUNIPERUS SCOPULORUM AND PSEUDOTSUGA MENZIESII, WITH CERCOCARPUS LEDIFOLIUS AND ERIGERON COMPOSITUS.

Land owner/manager:

BLM: HEADWATERS RESOURCE AREA, BUTTE DISTRICT
STATE LAND - UNDESIGNATED

Information source:

SCHASSBERGER, L.A. 1988. FIELD SURVEY IN SOUTHWEST MONTANA, 1-3, 6-7 AND 13-15 JUNE.

ARABIS FECUNDA
SAPPHIRE ROCKCRESS

Element occurrence code: PDBRA06290.008

Global rank: G2 Forest Service status: WATCH LIST
State rank: S2

Survey site name: UPPER QUARTZ HILL GULCH
County: Beaverhead

USGS quadrangle: VIPOND PARK
CATTLE GULCH

Township-range: 001S010W Section: 19 SE4
Township-range comments: Sec 20 SW4; Sec 29 NW4; Sec 30 NE4.

Survey date: 1988-06-07 Elevation: 7500
First observation: 1988 Slope/aspect:
Last observation: 1988-06-07 Size (acres): 40

Location:

CA. 3.75 MILES SOUTH OF DEWEY, MT, ALONG QUARTZ HILL GULCH
ROAD, CA. 0.2 MILE SW OF ROAD.

Element occurrence data:

CA. 75-100 PLANTS, FLOWERING AND FRUITING. SCATTERED PLANTS,
USUALLY ON EXPOSED OUTCROPS.

General site description:

ON CALC-SILICATE ROCKY OUTCROPS AND HILLSIDES; BENEATH
PSEUDOTSUGA MENZIESII, WITH CERCOCARPUS LEDIFOLIUS AND DRABA
NIVALIS.

Land owner/manager:

BEAVERHEAD NATIONAL FOREST, WISE RIVER RANGER DISTRICT

Information source:

SCHASSBERGER, L.A. 1988. FIELD SURVEY OF SOUTHWESTERN
MONTANA, 1-2, 6-7 AND 13-15 JUNE.

ARABIS FECUNDA
SAPPHIRE ROCKCRESS

Element occurrence code: PDBRA06290.009

Global rank: G2 Forest Service status: WATCH LIST
State rank: S2

Survey site name: SPRING GULCH II
County: Beaverhead

USGS quadrangle: WISE RIVER

Township-range: 001S011W Section: 01
Township-range comments: SE4

Survey date: 1988-06-07 Elevation: 5600
First observation: 1988 Slope/aspect:
Last observation: 1988-06-07 Size (acres): 10

Location:

CA. 2.2 MILES EAST OF WISE RIVER, MT, ON HIGHWAY 43. AT BEND, 0.20 MILE SOUTH OF ROAD, ATOP STEEP CLIFFS.

Element occurrence data:

CA. 100-200 PLANTS, FRUITING; SPARSELY DISTRIBUTED.

General site description:

ON CALC-SILICATE ROCKY OUTCROPS, BENEATH JUNIPERUS SCOPULORUM AND PSEUDOTSUGA MENZIESII, WITH CERCOCARPUS LEDIFOLIUS.

Land owner/manager:

BLM: DILLON RESOURCE AREA, BUTTE DISTRICT

Information source:

SCHASSBERGER, L.A. 1988. FIELD SURVEY, SOUTHWEST MONTANA, 1-3, 6-7 AND 13-15 JUNE.

ARABIS FECUNDA
SAPPHIRE ROCKCRESS

Element occurrence code: PDBRA06290.010

Global rank: G2 Forest Service status: WATCH LIST
State rank: S2

Survey site name: WISE RIVER
County: Silver Bow

USGS quadrangle: WISE RIVER
DEWEY

Township-range: 001S010W Section: 06 NE4NE4
Township-range comments: Sec 5 NW4NW4

Survey date: 1988-06-07 Elevation: 5600
First observation: 1988 Slope/aspect:
Last observation: 1988-06-07 Size (acres): 1

Location:

1.0 MILE WEST OF DEWEY, MT, ON HIGHWAY 43, 0.33 MILE NORTH OF
ROAD ON THE NORTH SIDE OF WISE RIVER.

Element occurrence data:
CA. 100+ PLANTS, FRUITING.

General site description:

ON CALC-SILICATE ROCKY OUTCROPS AND SOILS, BENEATH JUNIPERUS
SCOPULORUM AND PSEUDOTSUGA MENZIESII, WITH CERCOCARPUS
LEDIFOLIUS.

Land owner/manager:

BLM: HEADWATERS RESOURCE AREA, BUTTE DISTRICT
PRIVATELY OWNED LAND (INDIVIDUAL OR CORPORATE)

Information source:

SCHASSBERGER, L.A. 1988. FIELD SURVEY OF SOUTHWEST MONTANA,
1-3, 6-7 AND 13-15 JUNE.

ARABIS FECUNDA
SAPPHIRE ROCKCRESS

Element occurrence code: PDBRA06290.011

Global rank: G2 Forest Service status: WATCH LIST
State rank: S2

Survey site name: CANYON CREEK
County: Beaverhead

USGS quadrangle: CATTLE GULCH
 VIPOND PARK

Township-range: 002S010W Section: 08 N2
Township-range comments: Sec 5 S2, Sec 6 SE4, Sec 7 NE4

Survey date:	1988-06-13	Elevation:	7000
First observation:	1988	Slope/aspect:	3-35%+/ S,SW,SE
Last observation:	1989-06-16	Size (acres):	200

Location:

PIONEER MOUNTAINS, CANYON CREEK AND VIPOND CREEK DRAINAGES,
CA. 12 MILES WEST OF MELROSE, MT, ALONG CANYON CREEK ROAD
(BEAVERHEAD N.F. RD. #187); ON SLOPES ABOVE OLD KILNS, AND
ABOVE VIPOND CREEK.

Element occurrence data:

CA. 10,000+ FLOWERING PLANTS IN 3 SUBPOPULATIONS; FLOWERING
AND FRUITING OVER A LARGE AREA.

General site description:

ON ROCKY CALC-SILICATE SLOPES, BENEATH PINUS FLEXILIS AND
PSEUDOTSUGA MENZIESII, WITH ARTEMISIA TRIDENTATA, A.
FRIGIDA, ERIGERON COMPOSITUS, CERCOCARPUS LEDIFOLIUS,
AGROPYRON SPICATUM, PINUS CONTORTA AND POTENTILLA FRUTICOSA.

Land owner/manager:

BEAVERHEAD NATIONAL FOREST, WISE RIVER RANGER DISTRICT

Information source:

SCHASSBERGER, L.A. 1988 FIELD SURVEY, SOUTHWEST MONTANA,
1-3, 6-7 AND 13-15 JUNE.

ARABIS FECUNDA
SAPPHIRE ROCKCRESS

Element occurrence code: PDBRA06290.012

Global rank: G2 Forest Service status: WATCH LIST
State rank: S2

Survey site name: LIME GULCH
County: Beaverhead

USGS quadrangle: TWIN ADAMS MOUNTAIN

Township-range: 005S010W Section: 14 W2
Township-range comments: Sec 15 SE4

Survey date:	1988-06-15	Elevation:	6200
First observation:	1988	Slope/aspect:	- / east, west
Last observation:	1988-06-15	Size (acres):	80

Location:

5 MILES WEST OF INTERSTATE-15, UP BIRCH CREEK ROAD. NORTH OF ROAD, ON EAST AND WEST FACES OF LIME GULCH.

Element occurrence data:

CA. 10,000+ PLANTS, FRUITING. OLD MINING ACTIVITY IN AREA.

General site description:

CALC-SILICATE ROCK OUTCROPS AND HILLSIDES, BENEATH JUNIPERUS SCOPULORUM, WITH CERCOCARPUS LEDIFOLIUS, SENECIO CANUS AND ERIGERON COMPOSITUS.

Land owner/manager:

BEAVERHEAD NATIONAL FOREST, WISE RIVER RANGER DISTRICT

Information source:

SCHASSBERGER, L.A. 1988. FIELD SURVEY, SOUTHWEST MONTANA, 1-3, 6-7 AND 13-15 JUNE.

ARABIS FECUNDA
SAPPHIRE ROCKCRESS

Element occurrence code: PDBRA06290.013

Global rank: G2 Forest Service status: WATCH LIST
State rank: S2

Survey site name: CATTLE GULCH
County: Beaverhead

USGS quadrangle: CATTLE GULCH

Township-range: 002S010W Section: 01 NW4, NE4SW4
Township-range comments: Sec 2 NE4: T1S R10W, Sec 36 SW4

Survey date:	1989-06-07	Elevation:	6200
First observation:	1989	Slope/aspect:	15-35%/S,SW
Last observation:	1989-06-07	Size (acres):	160

Location:

PIONEER MOUNTAINS, CATTLE GULCH, 1.0-1.65 AIR MILES
NORTHWEST OF CONFLUENCE OF CATTLE GULCH AND CANYON CREEK,
CA. 7 AIR MILES NORTHWEST OF MELROSE, MT.

Element occurrence data:

127 PLANTS COUNTED (84 FLOWERING, 43 STERILE); FOUR
SUBPOPULATIONS; SLOPES LARGELY UNDISTURBED, ALTHOUGH THERE
HAS BEEN SOME PAST GRAZING IN THE BOTTOM OF CATTLE GULCH.

General site description:

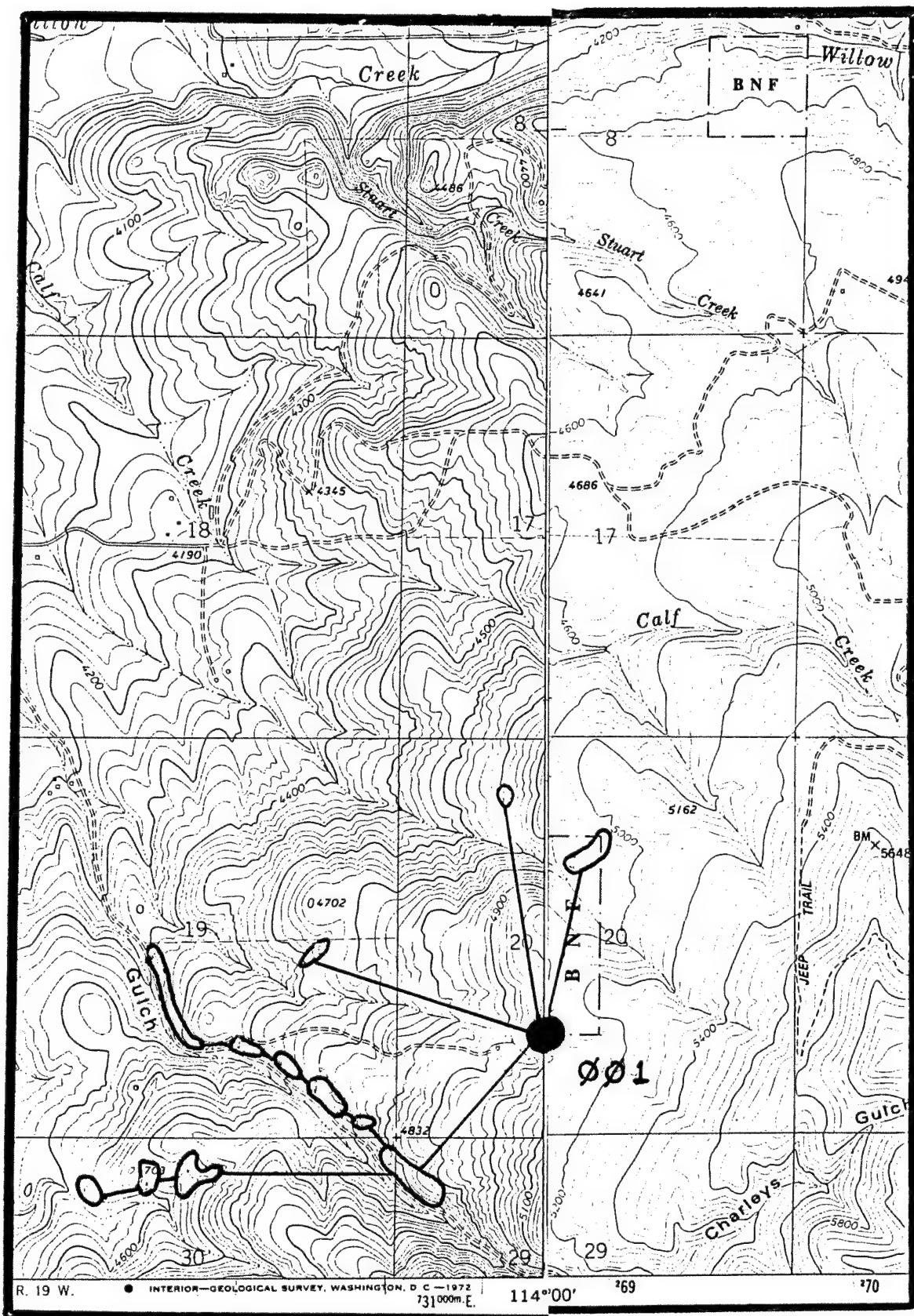
IN DRY, GRAVELLY CALCAREOUS SOILS ON STEEP SLOPES;
CERCOCARPUS LEDIFOLIUS/AGROPYRON SPICATUM TYPE, WITH
ARTEMISIA FRIGIDA, PHYSARIA GEYERI, LINUM PERENNE, SENECIO
CANUS, GUTIERREZIA SAROTHRAE, CYMOPTERUS BIPINNATUS, AND OPUNTIA
POLYACANTHA.

Land owner/manager:

BEAVERHEAD NATIONAL FOREST, WISE RIVER RANGER DISTRICT

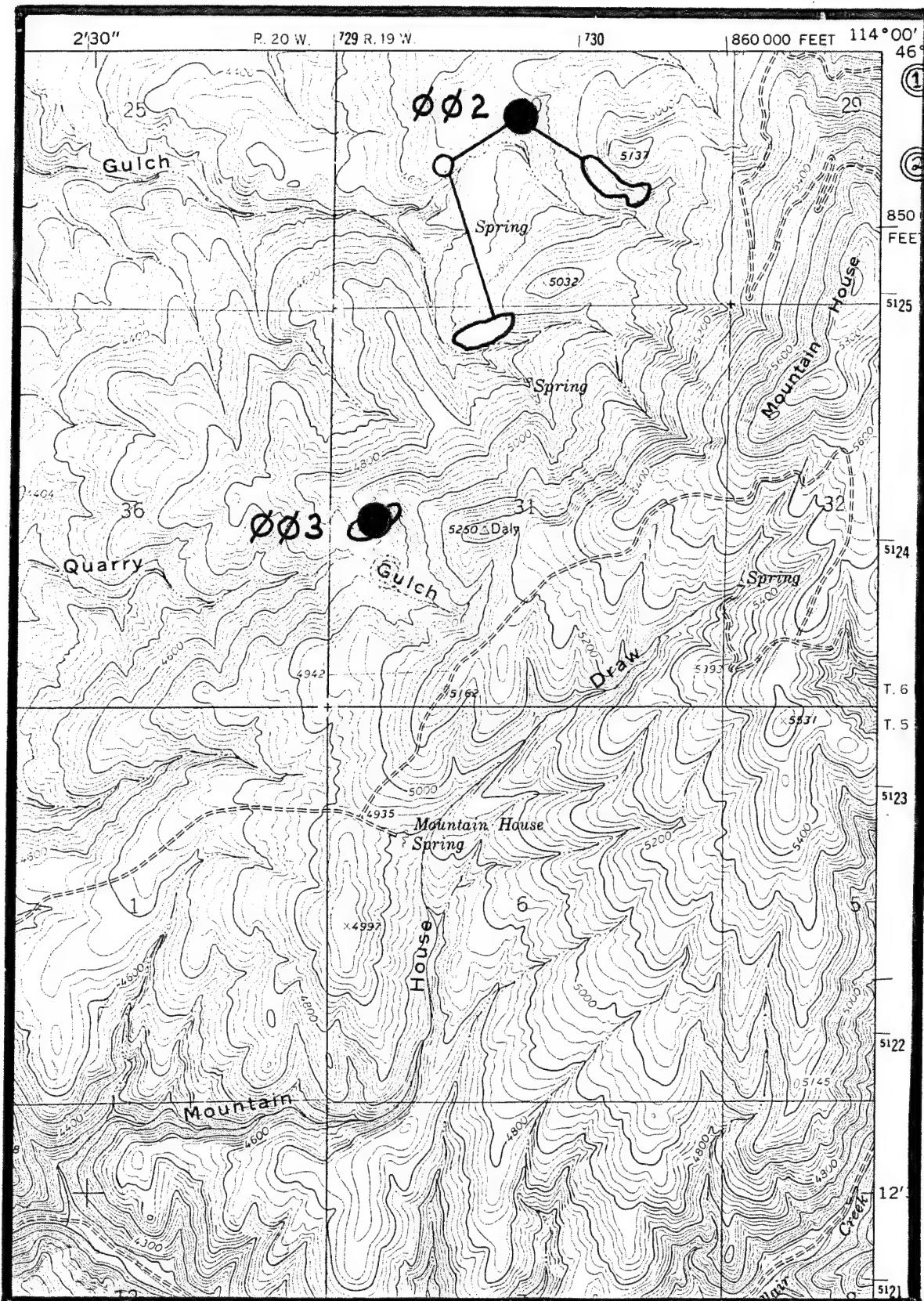
Information source:

SHELLY, J.S. 1989. FIELD SURVEYS IN BEAVERHEAD COUNTY, 5-9
JUNE.



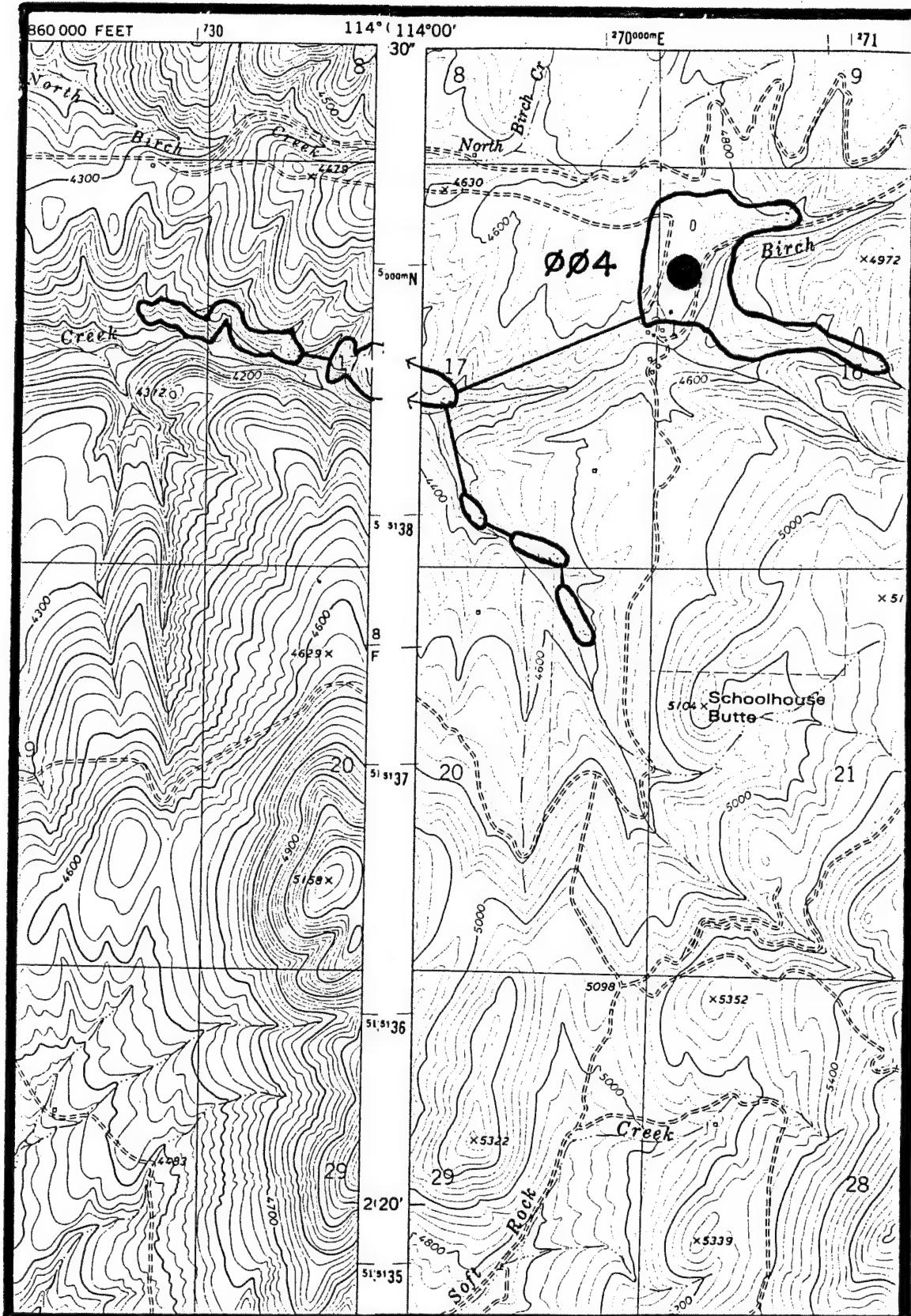
USGS Corvallis (left) and Willow Mountain (right) (7.5') quadrangles.

Charleys Gulch (001)



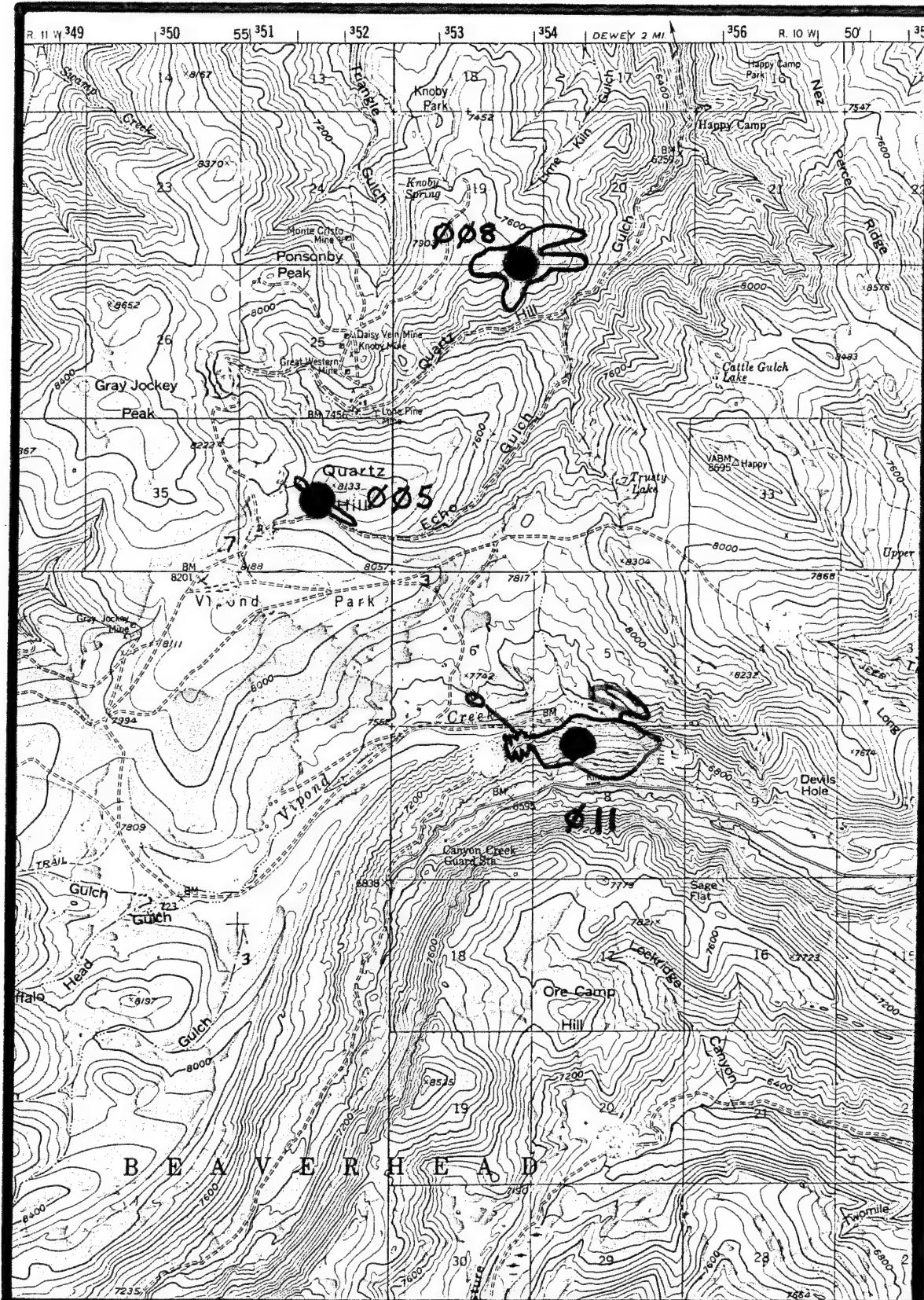
USGS Mountain House (7.5') Quadrangle.

Spring Gulch (002)
Rock Quarry Gulch (003)



USGS Corvallis (left) and Willow Mountain (right) (7.5') quadrangles.

Birch Creek Bluffs (004)

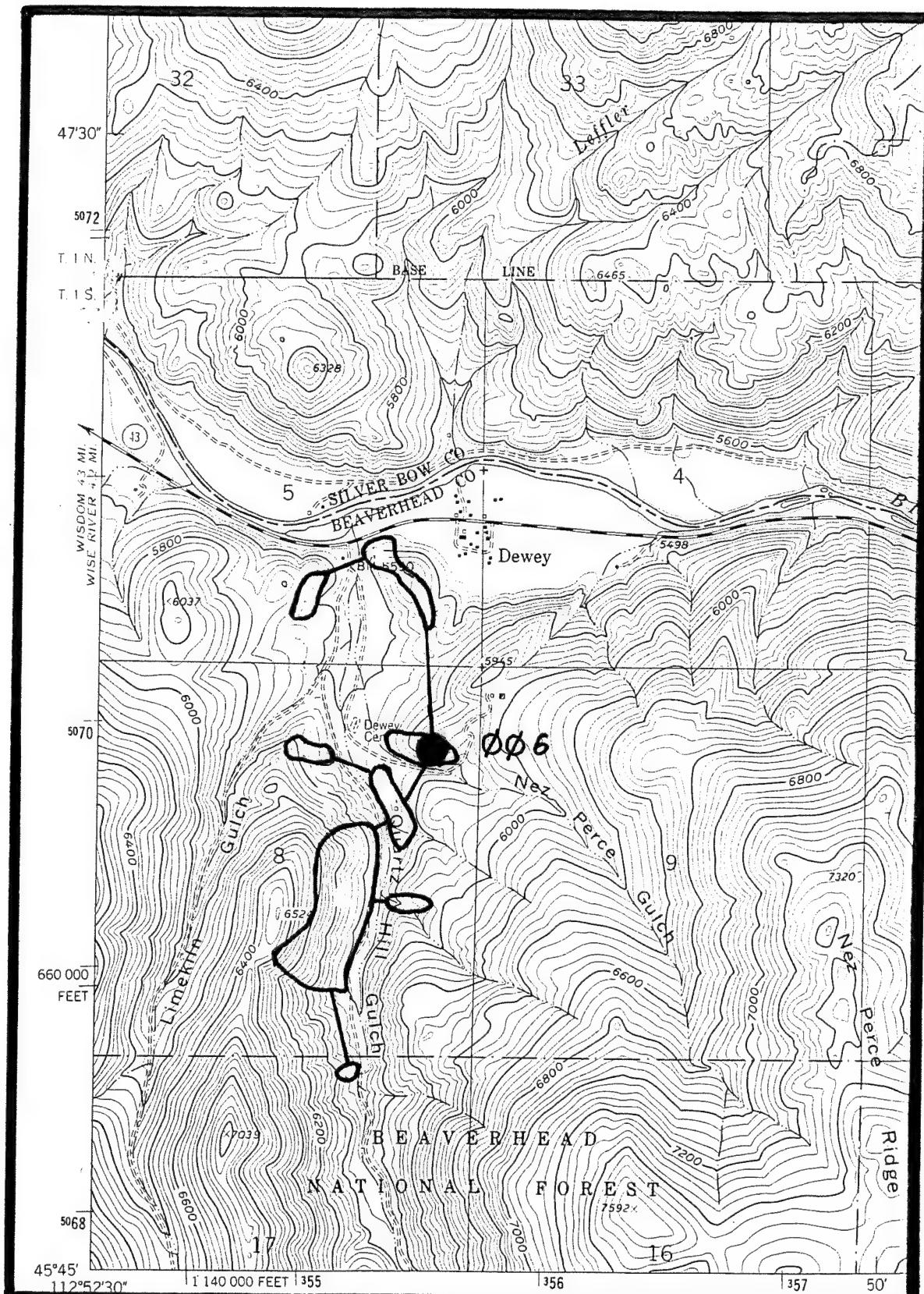


USGS Vipond Park (15') Quadrangle.

Quartz Hill (005)

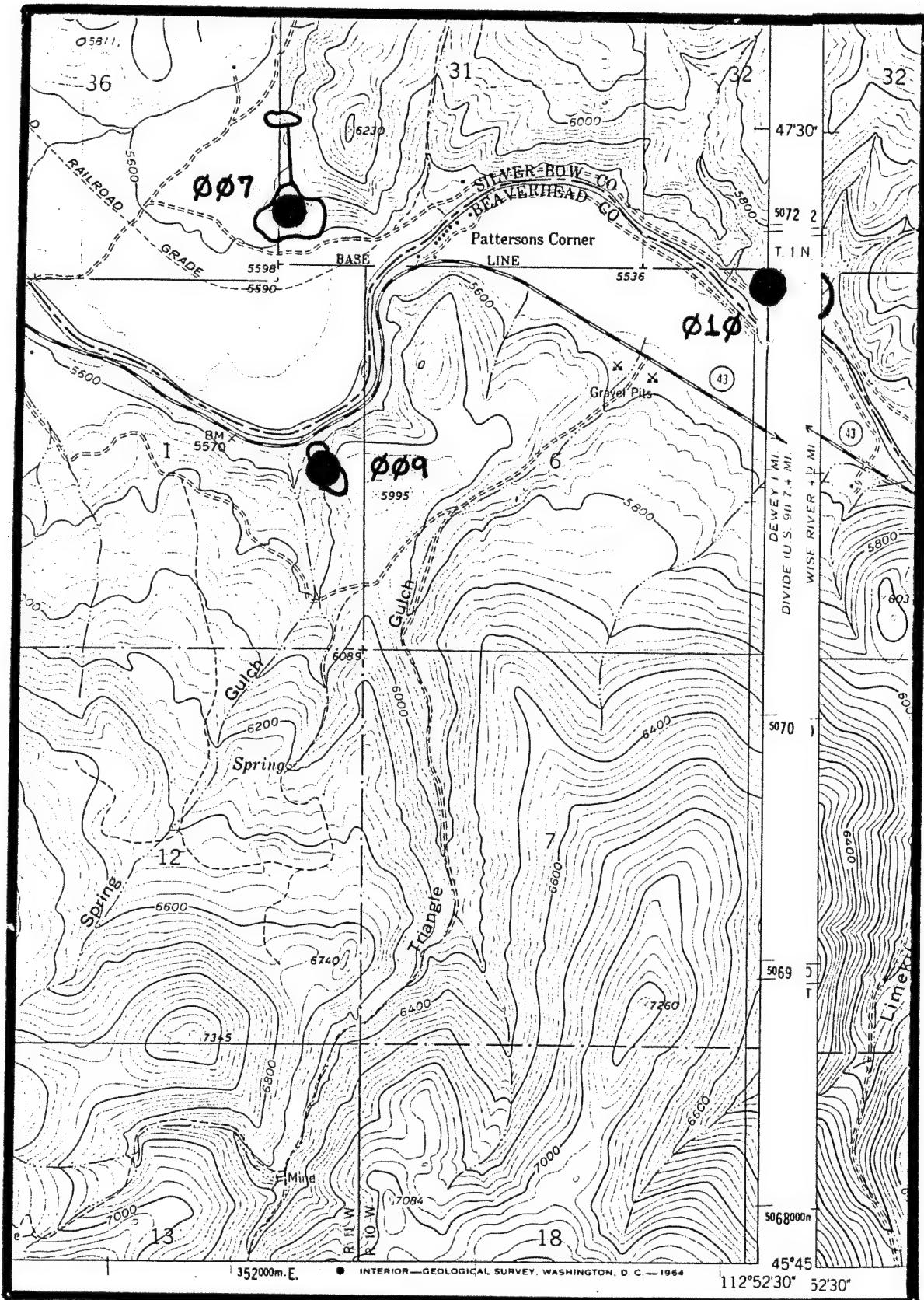
Upper Quartz Hill Gulch (008)

Canyon Creek (011)



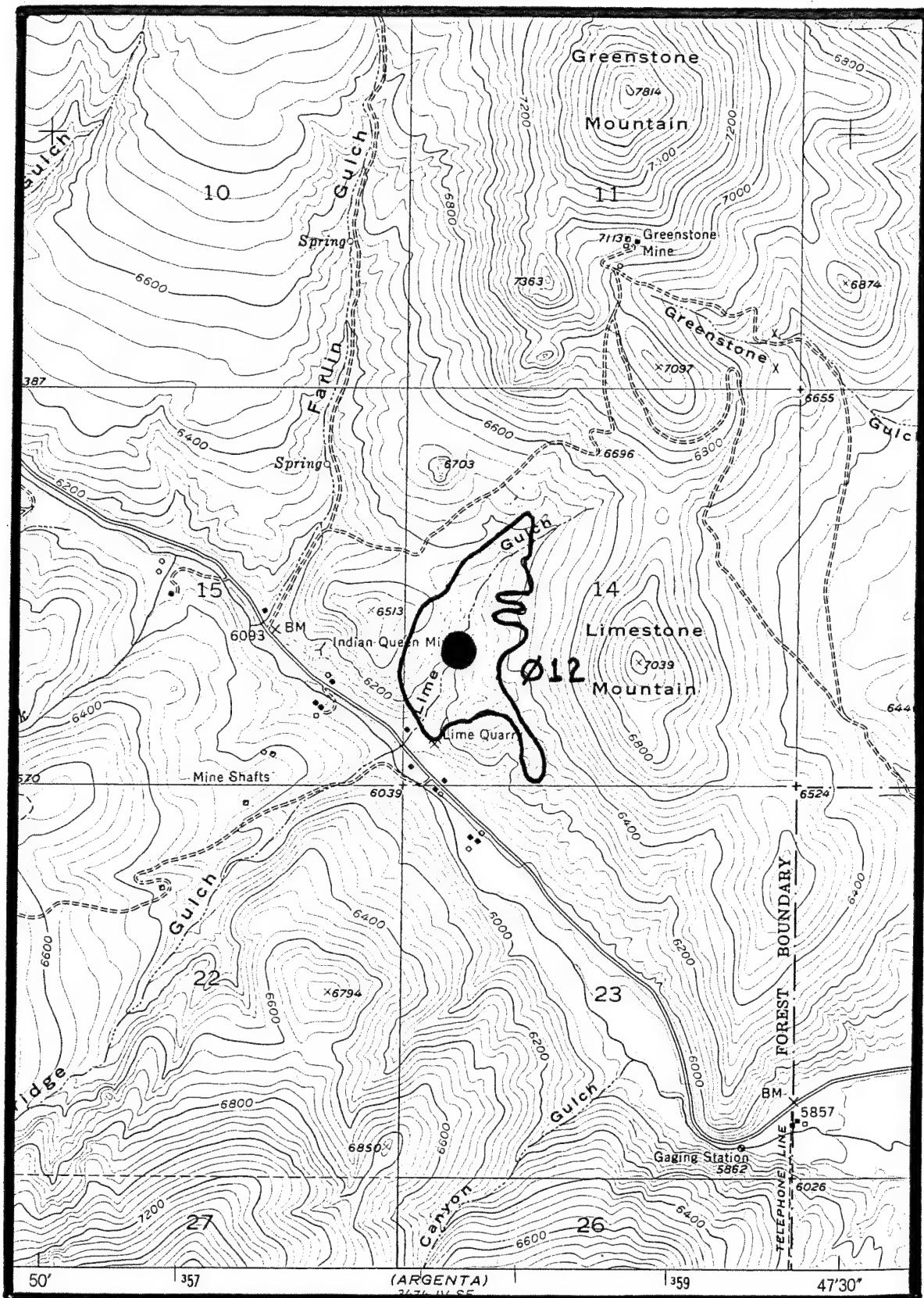
USGS Dewey (7.5') Quadrangle.

Mouth of Quartz Hill Gulch (006)



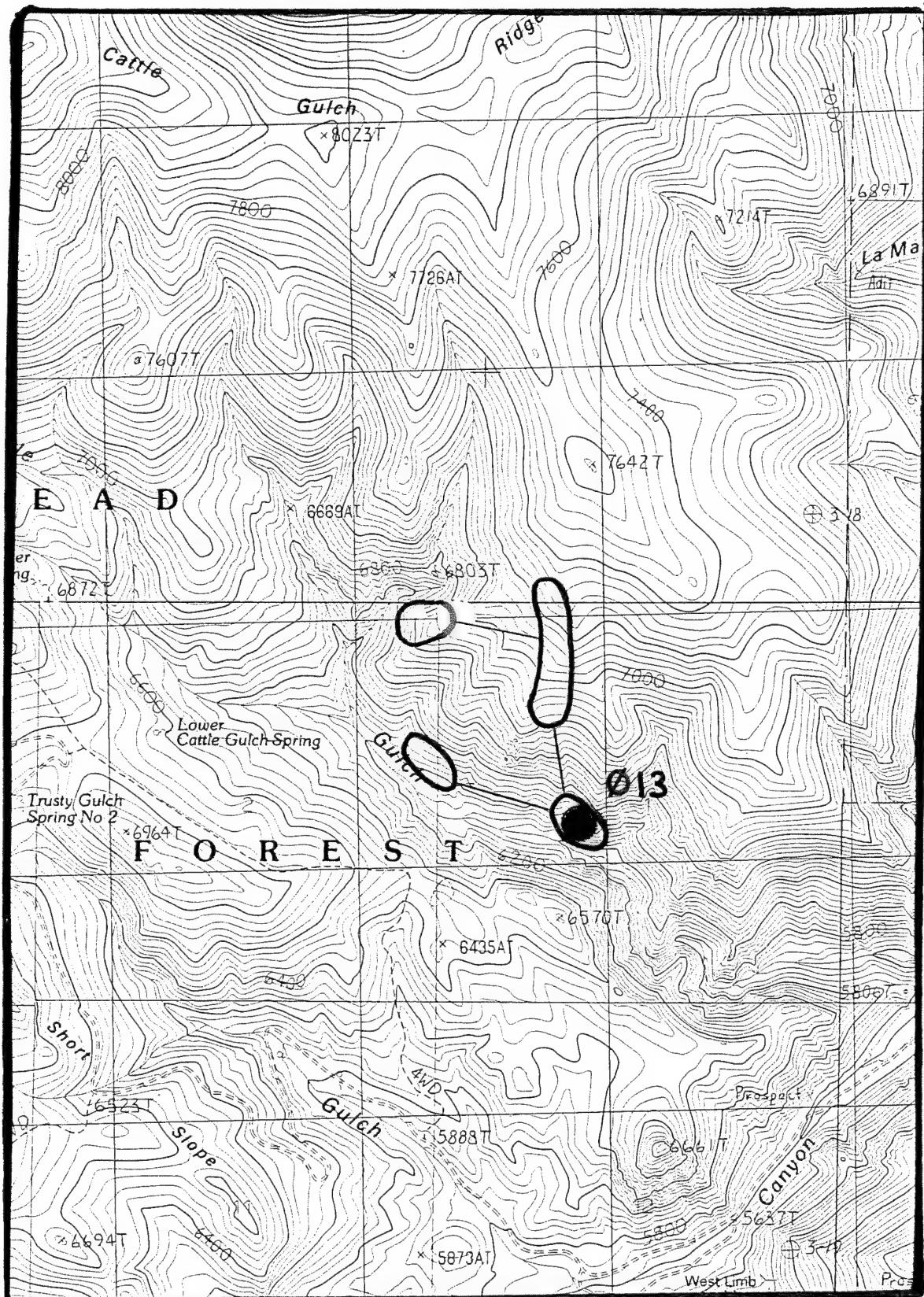
USGS Wise River (left) and Dewy (right) (7.5') quadrangles.

Mouth of Jerry Creek (007)
Spring Gulch II (009)
Wise River (010)



USGS Twin Adams Mountain (7.5') Quadrangle.

Lime Gulch (012)



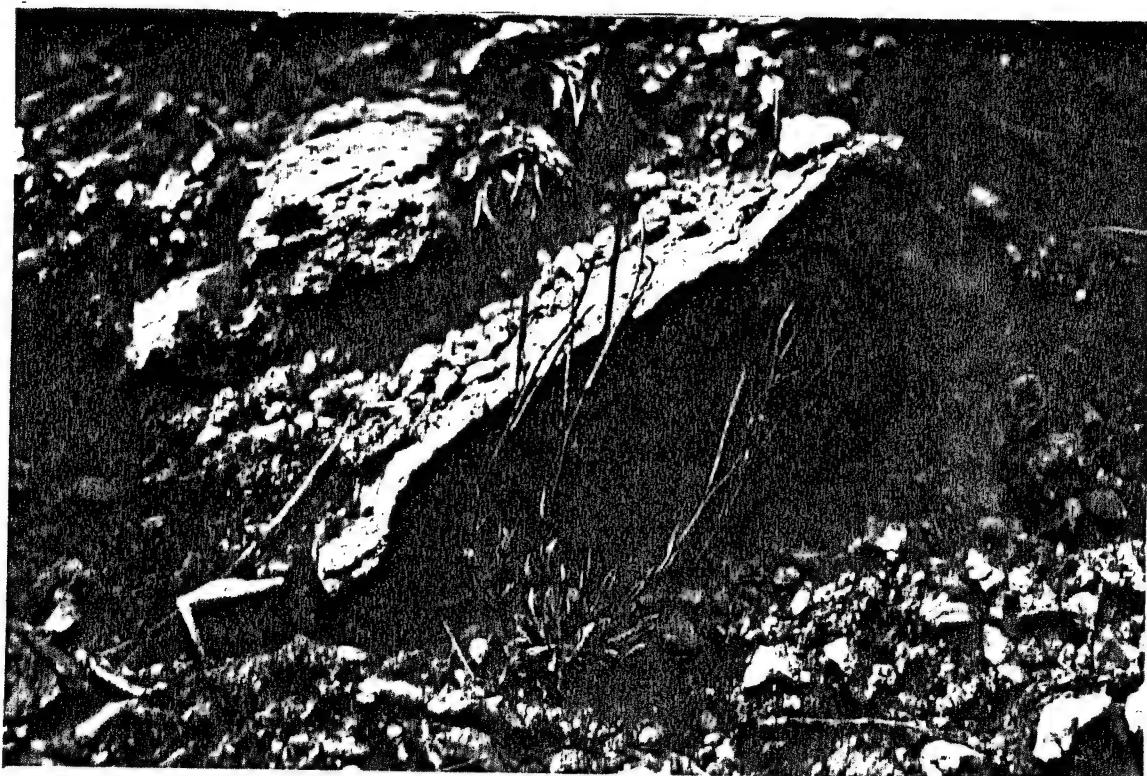
USGS Cattle Gulch (7.5') Quadrangle.

Cattle Gulch (013)

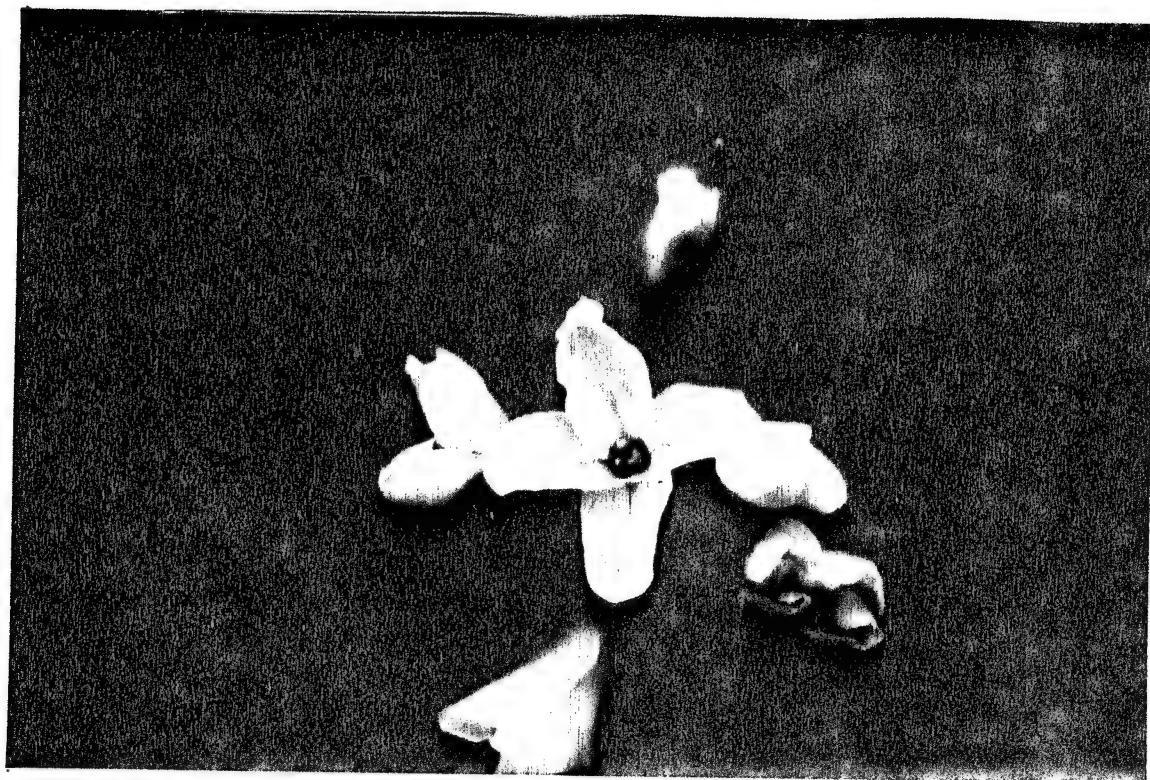
V. PHOTOGRAPHS



A. Arabis fecunda - habit.



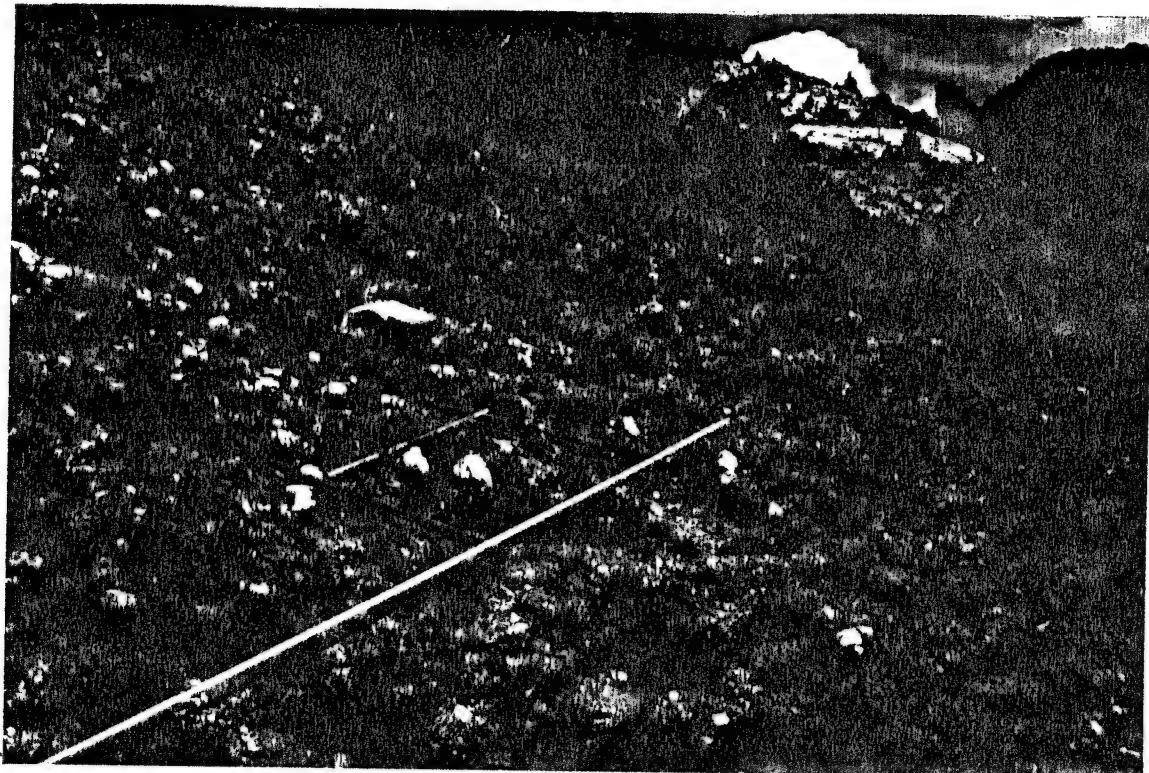
B. Arabis fecunda - habit.



C. Arabis fecunda - flower.



D. Arabis fecunda - habitat, Beaverhead N.F..



E. Arabis fecunda - transect, Beaverhead, N.F.
Lime Gulch (012).

APPENDIX A

DEMOGRAPHIC MONITORING OF ARABIS FECUNDA
IN THE PIONEER RANGE

1989 ESTABLISHMENT REPORT

Peter Lesica
The Nature Conservancy
Montana Field Office
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Helena, Mt 59624

and

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December 1989

INTRODUCTION

In order to adequately protect populations of an organism, it is necessary to understand its life history and population dynamics (Massey and Whitson 1980, Sutter 1986, Palmer 1987). In addition, many rare species are threatened by interactions with non-native species that have been introduced into their habitat (Drake 1988). It is important to understand the nature of these interactions in order to protect populations of rare species from extinction.

Sapphire rockcress (Arabis fecunda Rollins) is a rosette-forming perennial in the Mustard Family (Brassicaceae). This recently described species (Rollins 1984) is endemic to highly calcareous, azonal soils in the foothills of the Sapphire Range in Ravalli County, and in the Pioneer Range in Beaverhead and Silver Bow counties, Montana (Lesica 1985, Schassberger 1988). Arabis fecunda generally occurs on steep, often eroding slopes with low vascular plant density. In Ravalli County, populations of A. fecunda are thought to be threatened by livestock grazing and encroachment by an aggressive exotic weed, spotted knapweed (Centaurea maculosa) (Lesica 1985, Schassberger 1988). In Silver Bow and Beaverhead counties, populations may be threatened by mining activity and livestock grazing.

This report documents the establishment of demographic monitoring transects for Arabis fecunda at two sites in the Pioneer Range, on Beaverhead National Forest lands.

STUDY SITES

I. Lime Gulch

Location: Five miles west of Interstate Highway 15, on the north side of Birch Creek Road, approximately 1/4 mile up Lime Gulch from the road; T5S R10W Sec 14; ca. 6,200 ft elevation.

a. South Transect

Location: East-facing slope on the west side of the gulch, ca. 20 m up from the bottom. 98 degrees from the start pin to the summit of Limestone Mountain; 204 degrees to the summit of the grassy mountain south of Birch Creek Road. The start pin is next to an old juniper stump.

Line bearing: 21 degrees

Slope: 16 degrees

Aspect: 165 degrees

Instructions: Read transect south to north.

b. North Transect

Location: West-facing slope on the east side of the gulch, ca. 5 m above the bottom. 209 degrees from start pin to the summit of the bald hill with patches of trees; 17 degrees to the base of the Douglas fir snag near the bottom of the gulch.

Line bearing: 178 degrees

Slope: 22 degrees

Aspect: 274 degrees

Instructions: Read transect north to south.

II. Canyon Creek

Location: Approximately 12.5 miles west of Melrose on the Canyon Creek Road, at the corner of the road overlooking the kilns; T2S 10W Sec 8; 7,200 ft elevation.

a. West Transect

Location: Moderate, south-facing slope. 162 degrees from the start pin to the southwest-most kiln; 227 degrees to the junction of the guard station road.

Line bearing: 110 degrees

Slope: 31 degrees

Aspect: 205 degrees

Instructions: Read transect west to east.

b. East Transect

Location: Moderate, south-facing slope. 178 degrees from the start pin to southwest-most kiln; 48 degrees to wooden platform.

Line bearing: 96 degrees

Slope: 30 degrees

Aspect: 180 degrees

Instructions: Read transect west to east.

METHODS

On June 15 (Lime Gulch) and 16 (Canyon Creek), we established two permanent belt transects of 12 adjacent m^2 plots at each site, following the methods outlined in Lesica (1987). The start and end points of each transect were marked by a section of reinforcing bar driven into the ground and painted orange. Individual A. fecunda plants were mapped and recorded using the following system:

- S - Seedling (rosette less than 15 mm diameter)
- R - indicates the number of rosettes (> 15 mm diameter) per plant
- I - indicates the total number of inflorescences (stems) per plant
- F - indicates the total number of fruits produced by the plant

Thus, a plant with two rosettes, three stems and a total of nine fruits would be recorded as R1-I3-F9. In cases where plants had not finished blooming, two flowers or flower buds were recorded as one fruit. Since a first year plant can bloom and set fruit (Lesica and Shelly, personal observation), the above system describes size rather than age classes.

At each site, we located 25 randomly-chosen plants outside of the transects, and picked one fruit from each. We dissected each fruit, and recorded the number of viable-appearing seeds in each.

Many of the plants at Canyon Creek were still flowering when we read the transects; thus we recommend that this transect be read in late June or early July.

RESULTS AND DISCUSSION

A summary of the data collected in 1989 is presented in Table 1. All plants were mapped and scored to size class within each of the four transects. Fecundity was much greater in the Canyon Creek population than the Lime Gulch population. Also, the Canyon Creek population had a higher percentage of plants with more than one rosette. The Lime Gulch population is ca. 1,000 ft lower in elevation and in the rain shadow of the Pioneer Mountains. The differences in fecundity could be an artifact of

sampling on consecutive days at sites which have very different microclimates, i.e., the phenology of the two populations may not be the same. The reason(s) for the difference in rosette number is unknown.

Table 1. Population density and fecundity data for Arabis fecunda in long-term monitoring transects, Beaverhead National Forest, 1989.

	<u>Canyon Creek</u>	<u>Lime Gulch</u>
Density (plants/m ²)	15.8	15.4
# plants fruiting	95	6
% plants fruiting	25.1%	1.6%
# fruits per fruiting plant	10.8	3.2
# fruits per inflorescence	5.5	1.7
% plants with more than one rosette	20.3%	12.2%
% one-rosette plants with fruit	23.8%	0.9%
% multi-rosette plants with fruit	29.9%	6.7%
Seeds per fruit	34.2+10.5	31.1+5.6

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